



BAYESLINE

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Optimising Trading Objectives & Risk Management



Agenda

- Objectives of this presentation
- Common Trading Strategies and their shortcomings
- Bayes: brief introduction
- How this leads to a Better Approach



Objectives

- Explain the power of the Bayesian approach to risk management and profit optimisation
- Encourage at least one US-based trading company to work with us to fine tune a *Bayesian* workflow to your needs



Common Trading Strategies

- “Disciplined Trading”
- Algorithmic trading



Simplification of Basics

- Select stop loss
- Go short/long if trend is down/up
- Sell/buy when trend changes or hits lower/upper limits or barriers
- Get out if hit stop loss, keep trading otherwise until achieve objectives.



Shortcomings

- Missed Opportunities:
 - Not optimising over the whole trading “cycle”
 - Decisions are almost entirely triggered by the current price
 - Likelihood is high of hitting stop loss more often than profit objectives
- Incomplete risk management:
 - stop loss only



Other issues

- Most Traders use a similar approach:
 - Higher peaks and deeper troughs
- Results in more frequent transactions (or higher risk):
 - Higher costs
 - Favours high-speed responses e.g. “black boxes”



Bayesian statistics

- Formal statistical methodology, developed 1970-, gradually superseding classical methods.
- Characterized by mechanisms to:
 - combine diverse sources of information (data, human expertise, historical sources) to deliver superior results
- Becoming the method of choice for critical applications



Bayesian applications

- Microsoft – belief networks for trouble shooters
- NASA – space shuttle live telemetry and propulsion systems
- Medical diagnostic systems
- Nuclear industry and high-complexity software testing
- Complex model validation methods (e.g. war games, reservoir engineering)
- Many others



Bayes Example; type that frequently occurs

Trader estimates that $P(\text{crop failure in Brazil}) = 1/1,000,000$.

There is a piece of news he can get from a source which is pretty reliable – in the past the source has been right 95% of the time about any event that has been a big impact on the market.

The trader can also remember a few occasions when the tips were not right, maybe about 1% of the time.

Trader rings his source, and the source predicts a crop wipeout. What's the probability that there really will be a wipeout?

Would you like to say whether you think it's closer to 1 or to zero?



Bayes Example: answer

Answer: 0.00009499

Or about 1 in 10,000

Even though the source is reliable, the event is so rare that the posterior probability of wipeout remains very small.



Example: continued

We know $P\{\text{crop failure}\} = 1/1\text{million}$ and

$P\{\text{+ve feedback}/\text{when crop failure}\} = 0.95$, and

$P\{\text{+ve feedback}/\text{when no crop failure}\} = 0.01$.

But we need the $P\{\text{crop failure}/\text{+ve feedback}\} = 0.00009499$,

which Bayes formula provides.

In trading we are making judgments exactly like this example every day.

Human beings are simply not good at updating probabilities, particularly in taking account of other events, so this is best left to algorithms and computers.



Bayesian statistics

- Is an approach to statistics in which estimates and forecasts are based on combining **prior** knowledge (distribution) with sample data.
- Bayesian statistics is not a branch of statistics, but a completely holistic modern re-invention of statistical methodology.



Bayesian statistics

- It provides tools and techniques for all statistical problems.
- Every 20th century statistical method has a 21st century Bayesian equivalent, for example:
 - Bayesian forecasting (replaces standard forecasting);
 - Bayesian hypothesis testing, etc.



Bayesian statistics

- Bayesian methods formally employ information available from non-data sources, e.g.
 - expert judgment, past experience, historical data
- Couples with sample data



Bayesian statistics

- For process X and observed data Y , the data we see are $f(Y|X)$, i.e. the data are some function of a process
- The function is expressed in the language of uncertainty, i.e. probability.
- Our interest is in the process, X .



Bayesian statistics

- What we want to know is $f(X|Y)$, i.e. what the data Y tells us about X .
- Bayes theorem tells us that
$$f(X|Y) = [f(Y|X)f(X)]/f(Y)$$
 - {We can ignore $f(Y)$ in this discussion}
- $f(X)$ is the **prior** distribution, found by taking into account other sources of information



Bayesian statistics

- $f(X|Y)$ is the **posterior** distribution for X having seen Y .
- Broadly, it captures - in probability form - what we know about X having observed Y , **and taking into account what we already knew from other sources**
 - $f(\text{future prices/trader's belief, conf, prices to date})$
- $f(X|Y)$ provides our forecasts and error bounds



Bayesian: risk + attitude

- $f(X|Y)$ combines naturally with utility functions (to quantify attitudes to risk)
- and with decision making (maximise expected utility -> Profit)
- In trader terms, $f(X|Y)$ represents what you know having seen prices



Better Approach

- Understand and manage risk in real-time
- Combine the trader's know-how with the power of new mathematics & modern computers.
- Think longer term than just current price; optimise over the whole trading period



Real-time Risk Management

Customised “Static” Parameters

- Maximum Acceptable Loss; i.e. set Stop Loss
- Trader defines own risk attitude which is used in optimising decisions
- Set max short/long positions
- Set max buy/sell per trade

Customised “Dynamic” Parameters

- Trader expresses belief of where market is likely to go
- Trader states confidence in this belief
- Maximise Realisable Profit (RP) and Estimates **Risk** for future using:
 1. Bayes forecasts of prices for the remainder of the trading period taking account of:
 - a. Trader’s forecast
 - b. Stated confidence
 - c. Actual prices to date versus trader’s forecast
 - d. Current estimate of price volatility
 2. Also use Bayes to calculate a 90% confidence interval about price forecast



Bayesian: Real-time Guidance

- Monitors actual prices to:
 - Provide feedback diagnostics e.g.:
 - Original price forecast requires revision
 - state of market, e.g. market gone to a pure game
 - Increasing risk of hitting stop loss
- Recommends the optimal trades to make within the specified risk parameters.

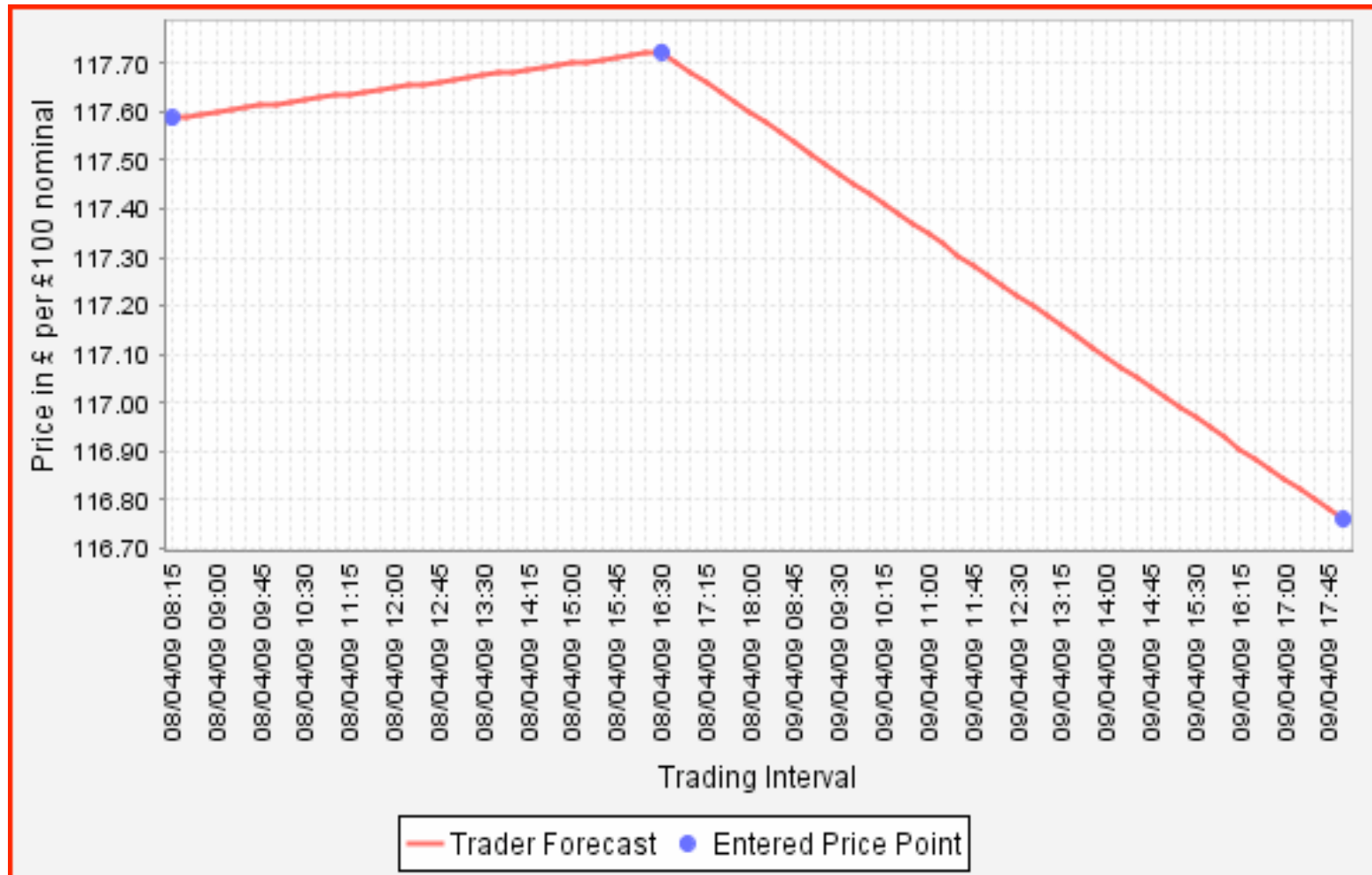


Who should use a Bayesian approach?

- Traders who have a view, however formed, valid or not, about how prices will evolve, then Bayes provides an advantage .
- Views allowed to change



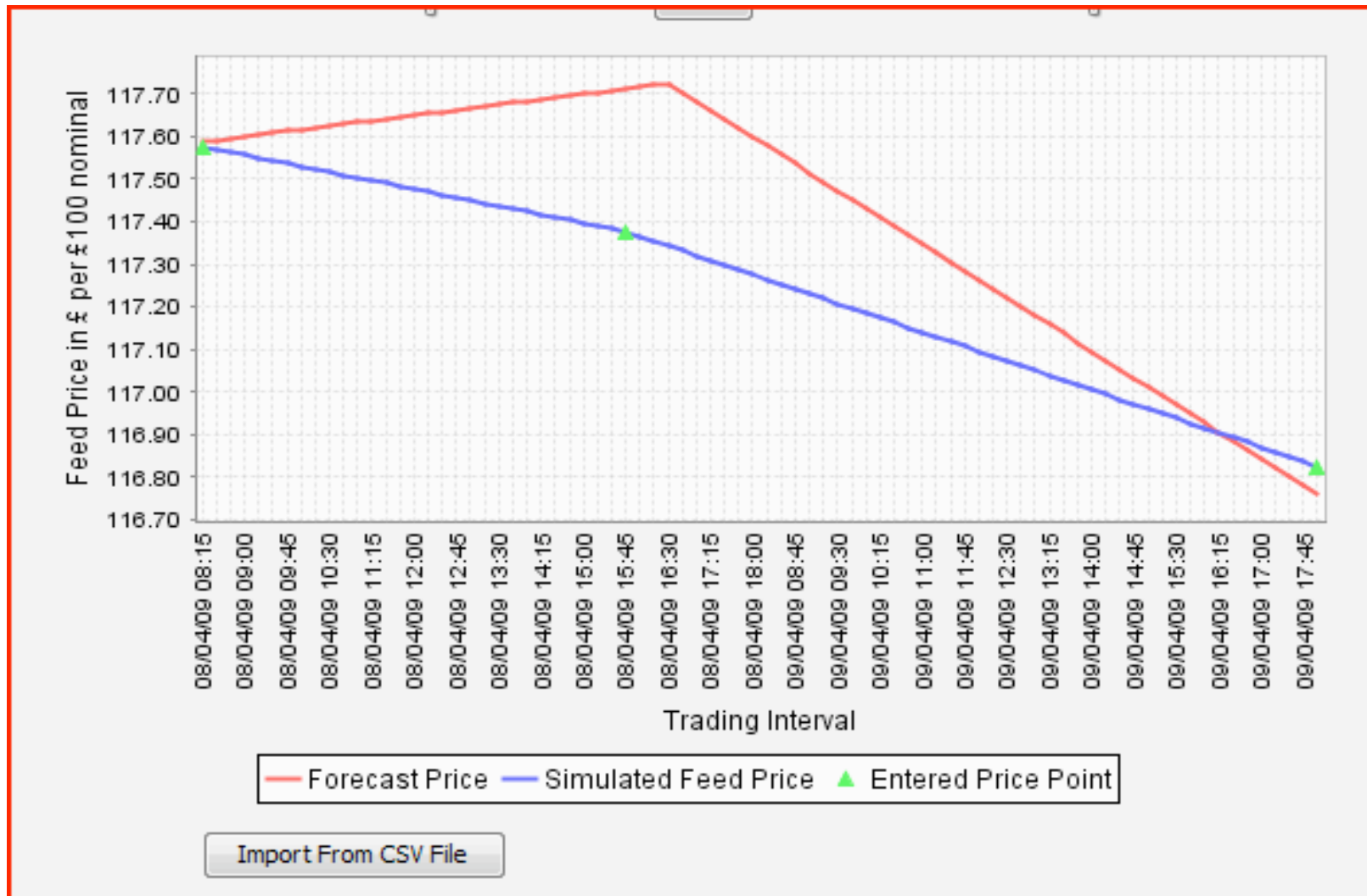
A Forecast



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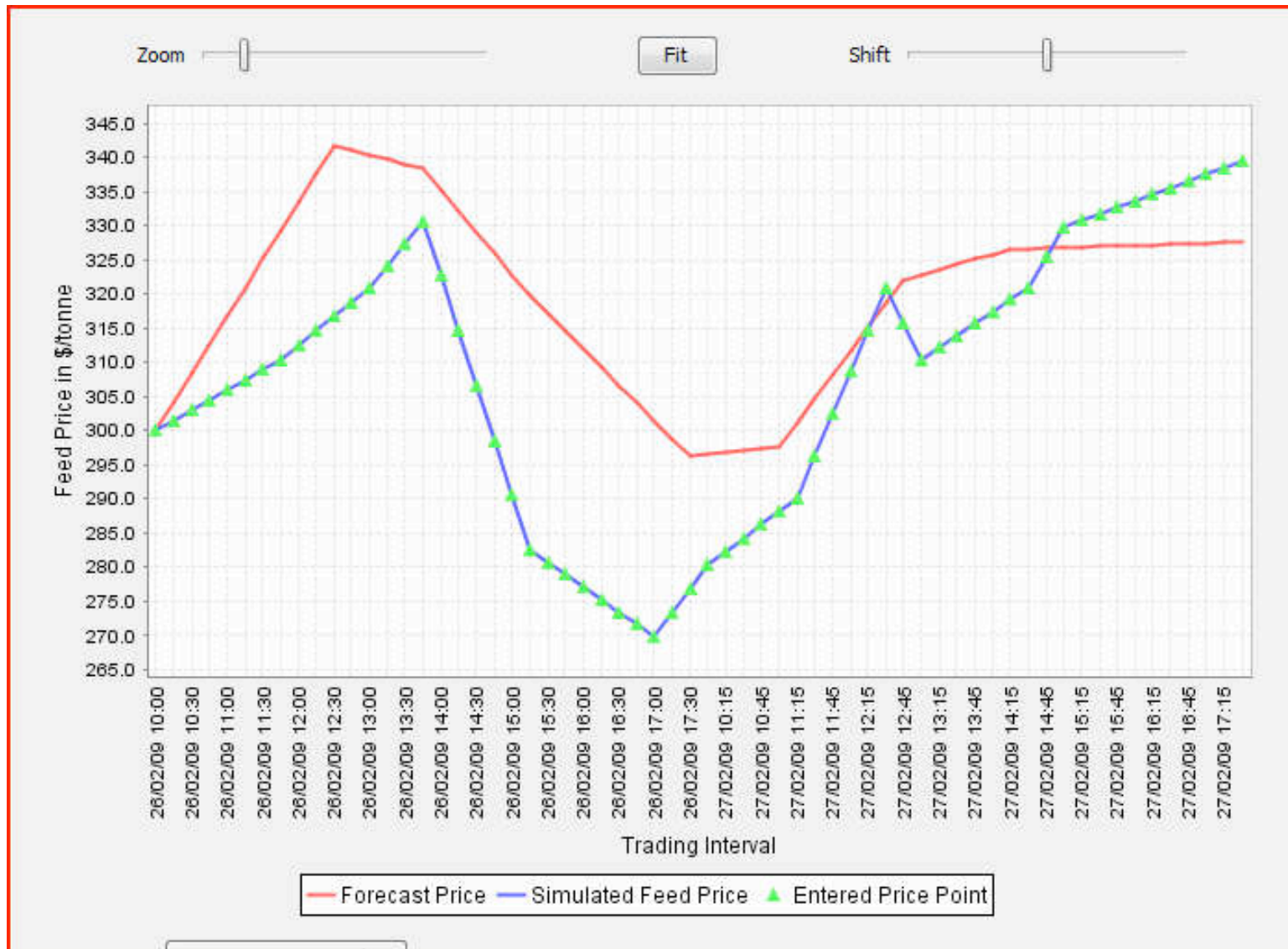
Forecast & "Actual"



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Price Forecast & "Actuals"



not distribute



Where do I get my forecast?

Traders can supply such a forecast:

- when they have information reflecting the market expertise of the trader, or
- confidential info on future prices, or
- just a feeling for how the market will develop, or
- provided by technical analysis of recent prices, e.g. from a package



I have ideas about future prices, why is this useful?

- In short, Bayesian approach will achieve
 - larger profits when your feelings are approx right, and
 - smaller downsides when you are wrong
- Bayesian statistics will combine your expertise/beliefs with live data and so give better results.



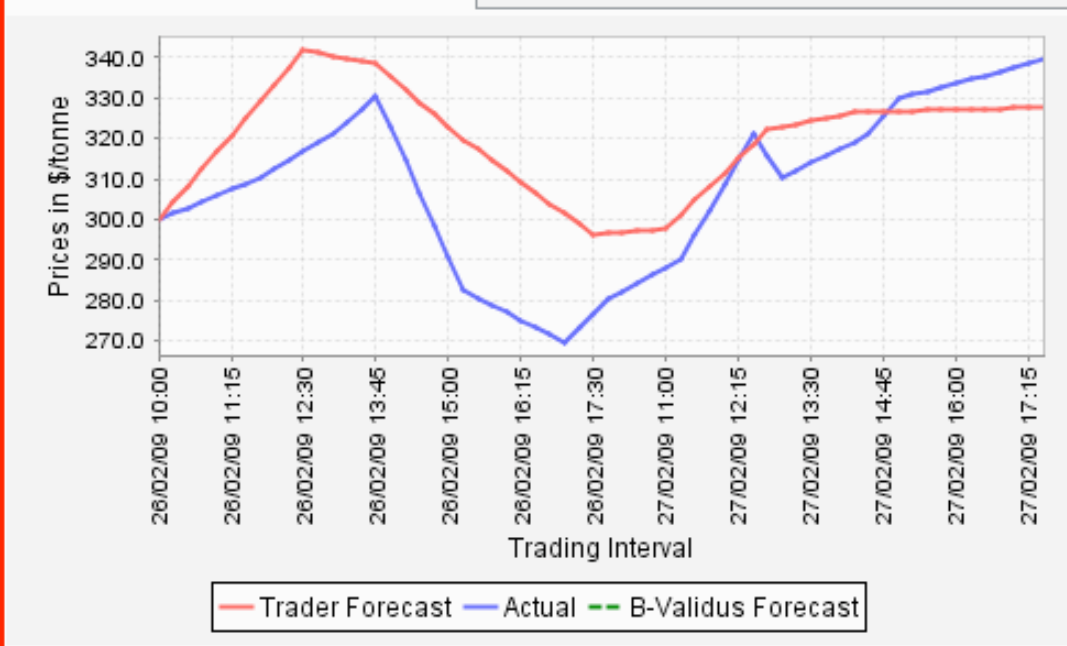
More information, better handled

- If you think you know where the market is headed, Bayes captures that know-how and exploits it
- If you are right, the recommendations will help you make more money
- If you are wrong, you will receive early alerts
- You can review/modify your forecast at any time

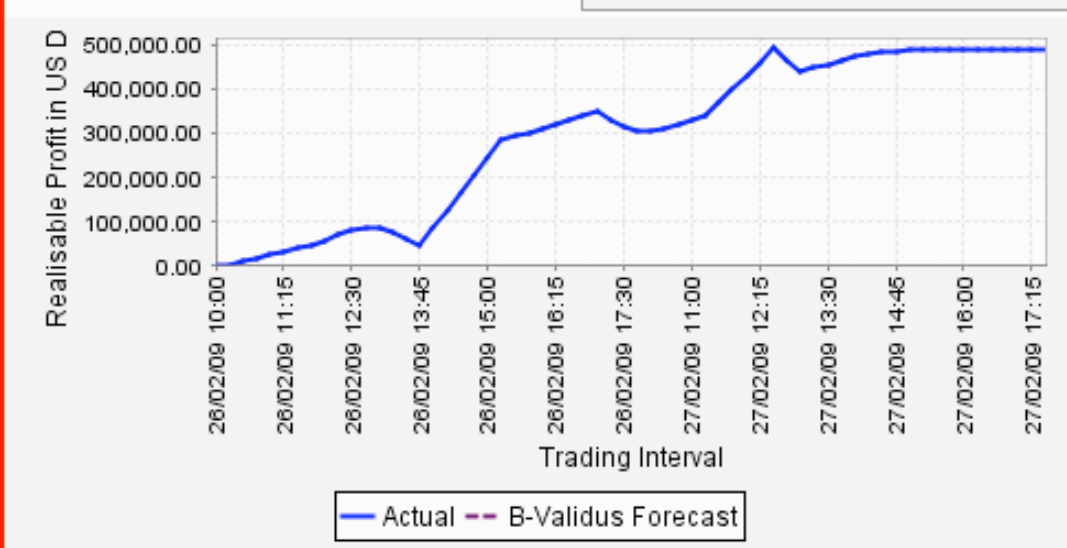


Position	UCIF	USOP	UPD	CVUL	CVUH	MLCB	AB	LF
LIFFE White Sugar Ma...								

LIFFE White Sugar May-09(16) Prices



LIFFE White Sugar May-09(16) Realisable Profit



Show	Now	#	End Time	Foreca...	Price	Recom...	Traded
24	26/02/09 16:00		311.9	277.0	0	0	
25	26/02/09 16:15		309.3	275.2	0	0	
26	26/02/09 16:30		306.7	273.4	0	0	
27	26/02/09 16:45		304.0	271.6	0	0	
28	26/02/09 17:00		301.4	269.7	0	0	
29	26/02/09 17:15		298.8	273.3	0	0	
30	26/02/09 17:30		296.2	276.8	+50	+50	
31	27/02/09 10:00		296.5	280.3	+50	+50	
32	27/02/09 10:15		296.8	282.3	+50	+50	
33	27/02/09 10:30		297.1	284.2	+50	+50	
34	27/02/09 10:45		297.4	286.1	0	0	
35	27/02/09 11:00		297.7	288.1	0	0	
36	27/02/09 11:15		301.2	290.0	0	0	
37	27/02/09 11:30		304.7	296.2	0	0	
38	27/02/09 11:45		308.2	302.4	0	0	
39	27/02/09 12:00		311.6	308.6	0	0	
40	27/02/09 12:15		315.1	314.7	0	0	
41	27/02/09 12:30		318.6	320.9	0	0	
42	27/02/09 12:45		322.1	315.6	0	0	
43	27/02/09 13:00		322.8	310.3	0	0	
44	27/02/09 13:15		323.6	312.1	0	0	
45	27/02/09 13:30		324.3	313.9	0	0	
46	27/02/09 13:45		325.0	315.6	-10	-10	
47	27/02/09 14:00		325.8	317.4	-14	-14	
48	27/02/09 14:15		326.5	319.2	-50	-50	
49	27/02/09 14:30		326.6	320.9	-13	-13	
50	27/02/09 14:45		326.7	325.3	-3	-3	
51	27/02/09 15:00		326.8	329.8	-4	-4	
52	27/02/09 15:15		326.9	330.7	-1	-1	
53	27/02/09 15:30		326.9	331.7	0	0	
54	27/02/09 15:45		327.0	332.7	-1	-1	
55	27/02/09 16:00		327.1	333.6	-1	-1	
56	27/02/09 16:15		327.2	334.6	0	0	
57	27/02/09 16:30		327.3	335.6	-1	-1	
58	27/02/09 16:45		327.4	336.5	0	0	
59	27/02/09 17:00		327.4	337.5	-1	-1	
60	27/02/09 17:15		327.5	338.5	-1	-1	
61	27/02/09 17:30		327.6	339.5	0	0	

Decision-making

- Need to quantify uncertainties:
 - but people don't do it naturally. They need help from decision-support tools.
- One issue is that the mathematics is complex and high-dimensional
- Another is that problems need proper structuring
- But the Bayes approach can do this for you with your help

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Managing risk

- Consequences of decisions must be made plain.
 - Large losses are more consequential than large gains
- Most organizations pay premiums to avoid risks (insurance). This does apply also to trading
- A usual way to manage risk is to define a utility function for gains and losses



Utility functions

- Utility functions are generally concave, displaying risk aversion
- This means that large losses are considered not balanced by a large equivalent gain
- A \$10m profit would be very welcome, but a \$10m loss could break the trader



Insurance Premiums against Risks

- The premium paid is the difference in profits under different risk strategies
- The more risk averse strategy adopted, the higher the premium



Bayesian risk tool

- Bayes tools then can maximise realisable profits **subject** to the given risk attitude
- Also sets a stop loss



Diagnostics

- The model created by Bayesian methods has a forecast and an expected forecast error for every new price arriving
- Diagnostics compare incoming prices to model forecasts
- Unusual market behaviour is signalled by one or more diagnostics changing colour

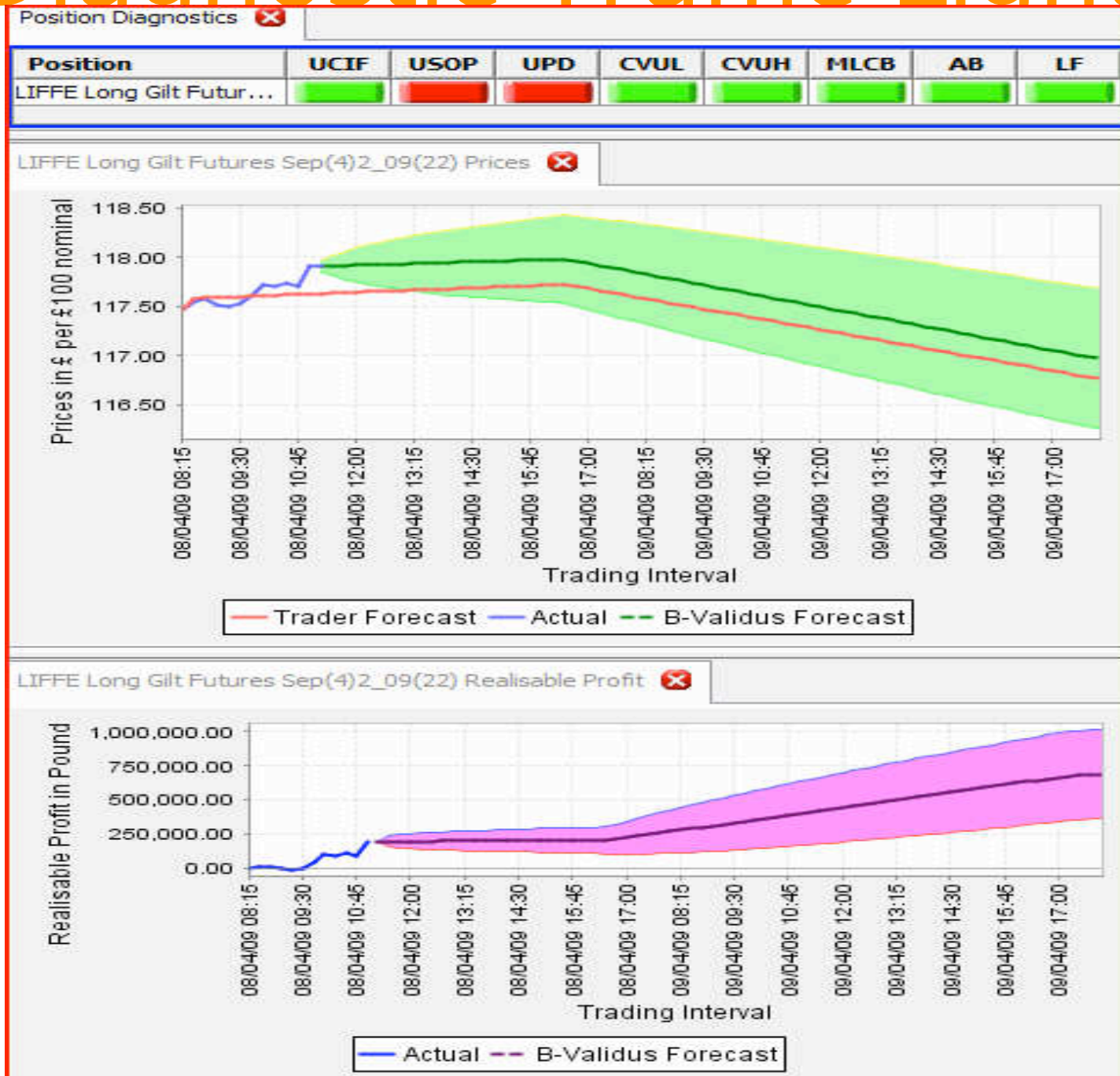


Some Bayesian diagnostics

- To monitor overall forecasts as actual prices arrive
- Assess the impact of price deviations on your trading position
- Tell you when your forecast needs review and when a change is critical
- To warn of approaching Stop Loss



Diagnostic Traffic Lights



Decision-support tool

- The bottom line is that:
 - if you work with a Bayesian approach, which embodies new advances in statistical technology and risk theory, and
 - if you commit to the ethos that evaluating market uncertainties is crucial,
- You will be much **better** placed to **exploit** a market.



Decision Support Tool

- No tool can replace you:
- You remain the domain expert and decision-maker, but well-supported



Bayesian based algorithms

- Utility package to help determine your risk attitude.
- Expertise package to help elicit trader judgements.
- Forecasting models
- Bayesian updating: forecasts and uncertainties
- Optimisation algorithms



A Brief Summary

- A Bayesian approach:
 - Helps the trader think about & structures his risk profile
 - Manages risk
 - Optimises profit over any selected trading interval within the chosen risk profile:
 - Larger profits/smaller losses
 - You can't beat a Bayes approach and stay within risk!
 - Provides guidance and warnings about how market develops



Follow-up

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Seminal Bayesian references

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- M. Goldstein and D.A. Wooff, *Bayes Linear Statistics: Theory and Methods*, 2007, Chichester: Wiley.

